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Experiment StationLIGHT-WEIGHT EXTENSION TUBES
FOR COMPRESSED-AIR GARDEN SPRAYERS

Abstract. To hand-spray taller trees safely and efficiently, 8-, 12-, and 16-foot extension tubes for compressed-air garden sprayers were designed and built. These light-weight tubes have been used successfully for spraying white pine leaders for weevil control on the Massabesic Experimental Forest in Maine. Bill of materials and assembly instructions are included.

Garden sprayers of the compressed-air type are often used to apply insecticides or other materials on small jobs or in other situations where power sprayers would not be practical. These garden sprayers usually come equipped with 2 to 3 feet of flexible hose and a 20-inch metal extension tube. Trees up to 6 feet tall can be sprayed with the unit. By replacing the standard tube with a 6-foot length of $\frac{1}{4}$ - or $\frac{3}{8}$ -inch i.d.¹ aluminum pipe, trees up to 10 feet tall can easily be sprayed.

However, situations often occur where it is necessary to spray trees taller than 10 feet. The need for a longer reach is particularly acute in spray regimes that call for protecting the leaders of young white pine trees from attack by the white-pine weevil (*Pissodes Strobi* Peck.).

But difficulties are encountered in attempting to spray these taller trees because 6 feet is about the practical maximum length of $\frac{1}{4}$ - or $\frac{3}{8}$ -inch pipe that can be used as an unsupported extension tube for such work. The increased weight of pipe and spray material, and the added leverage created by the longer length, may cause the pipe to break at the threaded end. Moreover, when lengths of pipe 10 feet and longer are assembled,

¹The abbreviations i.d. and o.d. are used in this note to denote inside diameter and outside diameter respectively.



Figure 1.—Spraying a young white pine for weevil control with the equipment described. The device on the upper end of the tube is a spray deflector, an optional extra attachment that helps direct the spray onto the pine leaders.

greater pressures are needed to support the column of liquid in the tube and to deliver it through the spray nozzle with sufficient pressure for effective coverage. More frequent pumping is required to maintain this pressure. Also, gaskets and hose connections tend to spring leaks or blow out under the higher pressures. Occasionally, the operator is partly soaked with spray material when a connection breaks. This is a hazard to his safety and health.

To hand-spray taller trees safely and efficiently, we designed and built 8-, 12-, and 16-foot extension tubes for compressed-air garden sprayers. These have been used successfully for spraying white pine leaders for weevil control on the Massabesic Experimental Forest in Maine (fig. 1). However, the 16-foot length was found to be too long for easy carrying and handling in stands of trees under normal working conditions in the field. A tube of this length will be useful mainly in research work where its full reach is needed to treat taller trees than would ordinarily be sprayed in routine weevil-control operations.

The extension tube consists of a support member made of aluminum tubing, a $\frac{1}{8}$ -inch i.d. copper tube to carry the liquid, and a flexible line to connect the copper tubing to the spray tank. If $\frac{1}{8}$ -inch copper tubing is used instead of the $\frac{1}{4}$ -or $\frac{3}{8}$ -inch tubing ordinarily used, the volume of liquid that has to be supported is greatly reduced; consequently both pressure requirements and the danger of leaks and blown gaskets are reduced.

Weights of assembled $\frac{1}{8}$ -inch tubes of different lengths, without nozzles and shut-off controls, are:

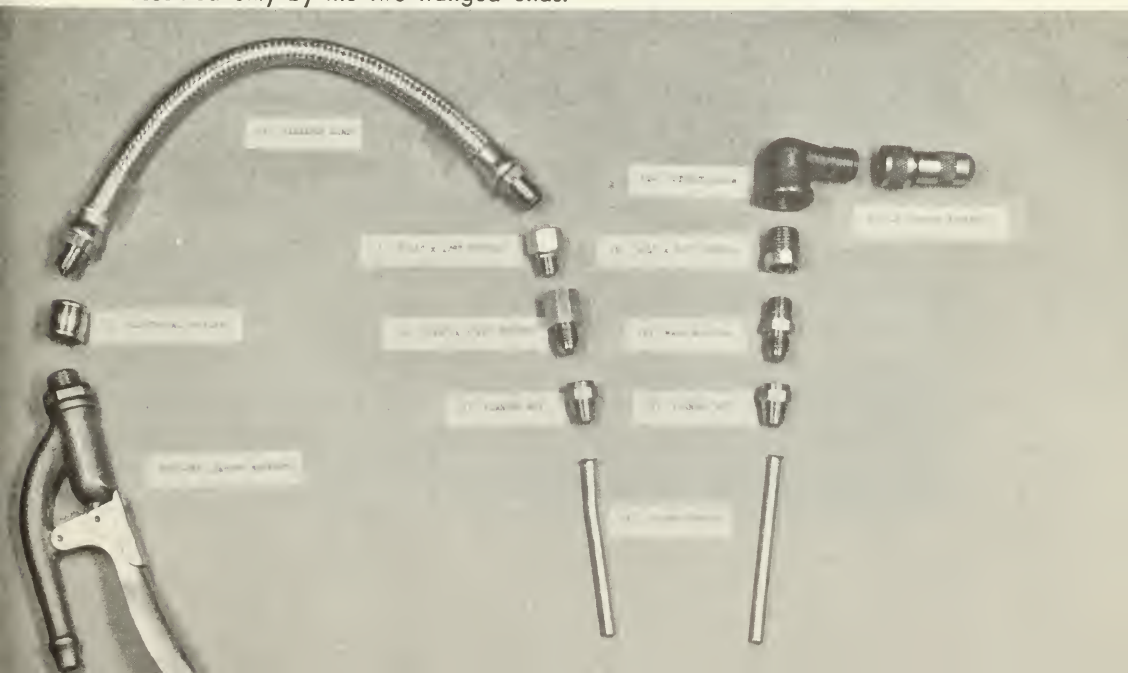
<i>Length (feet)</i>	<i>Weight (pounds)</i>
8	2 $\frac{1}{2}$
12	3 $\frac{1}{2}$
16	6 $\frac{1}{2}$

To assist others who may wish to convert a standard compressed-air garden sprayer into an effective tool for spraying taller trees, a description of the materials needed, together with instructions and illustrations for assembly, are presented below:

Materials

The various items required to assemble 8-, 12-, and 16-foot extension tubes are listed by tube length in the following bill of materials, and are illustrated in figures 2 and 3.

Figure 2.—The separate parts required for assembling an extension tube, except for the supporting aluminum tube. Copper tube is represented only by the two flanged ends.



	<i>Cost²</i>
<i>8-Foot Extension</i>	
Aluminum tubing, 3/4-inch o.d. x 0.083 inch wall ³ , 12 feet	\$4.50
Copper tubing, soft, 3/16-inch o.d., 8 feet @ 13c per foot	1.04
Flexible line (Edelmann Co. No. 482-9 ⁴)	1.40
Brass fittings, (see detailed list), set	1.54
	\$8.48
<i>12-Foot Extension</i>	
Aluminum tubing, 3/4-inch o.d. x 0.083 inch wall, 12 feet	\$4.50
Copper tubing, soft, 3/16-inch o.d., 12 feet @ 13c per foot	1.56
Flexible line (Edelmann Co. No. 482-9 ⁴)	1.40
Brass fittings, (see detailed list), set	1.54
	\$9.00
<i>16-Foot Extension</i>	
Aluminum tubing, 3/4-inch o.d. x 0.083 inch wall, 12 feet	\$4.50
Aluminum tubing, 1-inch o.d. x 0.125 inch wall ³ , 6 feet	4.25
Copper tubing, soft, 3/16-inch o.d., 16 feet @ 13c per foot	2.08
Flexible line (Edelmann Co. No. 482-24 ⁴)	2.07
Brass fittings, (see detailed list), set	1.54
	\$14.44
<i>Brass Fittings</i>	
Electrical coupling, pipe thread, 1/4-inch x 1/8-inch	\$0.15
Bushings, pipe thread ⁴ , 3/16-inch x 1/8-inch	0.00
Bushing, (pipe thread to flared copper) 3/16-inch x 3/16-inch	.27
Nut, flared copper, 3/16-inch, @ 10c each (2 each)	.20
Male adapter, (flared copper to pipe thread), 3/16-inch x 1/8-inch	.23
Street elbow, 1/4-inch, 90°	.50
	\$1.54

All items were purchased from established supply sources: aluminum tubing from a regional aluminum supply center; flexible line, including one fitting, from a local auto-parts supply company; and all other items from a local hardware store.

Assembly Instructions

The parts referred to by name or number in the following instructions are identified and pictured in figure 2.

²Purchase price as of March 1965.

³Aluminum tubing is sold only in 12-foot sections. There is an additional cutting charge if shorter sections are desired.

⁴Mention of a particular product should not be construed as an endorsement by the Forest Service or the U. S. Department of Agriculture. The Edelmann kit contains one fitting used in the assembly: the 3/16- by 1/8-inch bushing.

⁵This is half of a purchased 12-foot section of aluminum tubing that cost \$9.50.

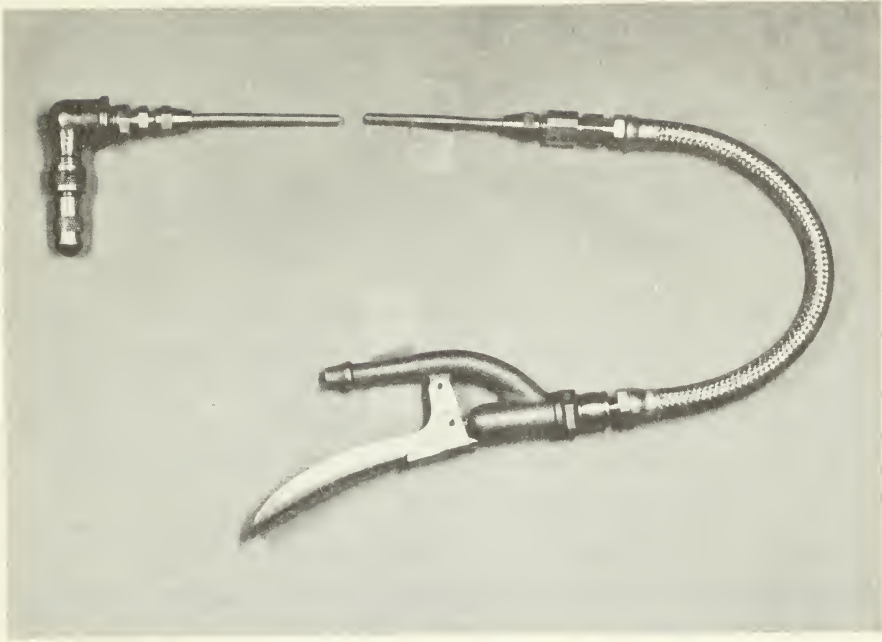


Figure 3.—Same parts as in Figure 2, assembled.

Aluminum Tube Assembly.

1. Ream one end for a distance of about 5 inches with a $\frac{5}{8}$ -inch drill. This is not necessary for the 16-foot extension tube.
2. At the other end, to take the modified bushing, (part 9—see *parts assembly*, item 3, below), file a short groove in the inner wall of the tube with a triangular file.
3. To make a 16-foot extension, insert the 12-foot section of $\frac{3}{4}$ -inch tube about 2 feet into the 1-inch tube and rivet in that position. Use “pop” rivets and the special tool for placing them so that the inside of the tube will not be obstructed.

Parts Assembly.

In the process of assembly, part of the flexible line is drawn into the reamed end of the aluminum tube in order to cut copper tubing the proper length and to put the nozzle end together. When the nozzle end assembly is seated in place on the aluminum tube, the locations for rivets through the tube will be concealed. Consequently, reference points need to be established and measurements taken to correctly locate rivet holes.

1. Lay out parts as shown in figure 2.
2. File points (the angled corners) of bushing, part 4, so that it fits easily into reamed end of aluminum tube.
3. File all but one point of bushing (part 9) so that it fits snugly into grooved end of aluminum tube. Unfiled point of bushing will fit into groove made for it.
4. Assemble and tighten fittings for shut-off end (parts 1-4). File a groove to enlarge the gap between the bushings (parts 3 and 4). Allow enough room to take $\frac{1}{8}$ -inch, off-center rivet through the aluminum tube (see item 14 below). Make a mark on the shoulder of the flexible line in such a way that the position of the groove can be visualized when inside the tube.
5. Measure and record distance from the junction of electrical coupling and flexible line (part 1 and 2) to the groove at junction of bushings (parts 3 and 4).
6. Assemble and tighten fittings for nozzle end (parts 8 to 10). If the gap between parts 8 and 9 is not wide enough to take a $\frac{1}{8}$ -inch off-center rivet (see item 16 below), enlarge as in item 4 above.
7. Place a flanged nut on one end of the copper tubing, flange the tubing, and attach flanged nut to flexible line assembly.
8. Insert copper tubing into aluminum tube with the shoulder of the flexible line just inside the reamed end of the aluminum tube.
9. Mark a point on the copper tubing flush with the grooved end of the aluminum tube. Pull copper tubing out as far as it will go (flexible line is pulled 3 or 4 inches into reamed end of the aluminum tube).
10. Measure distance from the larger or near end of the street elbow, (part 10) to the smaller end of adapter (part 8), and measure back this amount from mark previously made on copper tubing. Cut the copper tubing at this point.
11. Place flanged nut on copper tubing, flange the tubing, and attach flanged nut to nozzle end assembly.
12. Measure and record distance from near end of the elbow (part 10) to junction of bushing and adapter (parts 9 and 8).

13. Seat street elbow on end of aluminum tube with point of bushing, (part 9) in groove. The opposite end of the aluminum tube will then be about flush with the shoulder of the flexible line.
14. At this (the shut-off) end of the aluminum tube, mark a point at the distance recorded under item 5. Drill a $\frac{1}{8}$ -inch off-center hole through the aluminum tube at this point, oriented according to the mark specified in item 4 so the rivet will pass through the groove between the bushings (parts 3 and 4).
15. Insert rivet and head it.
16. Mark point on nozzle end of aluminum tube at distance recorded under item 12. Drill a $\frac{1}{8}$ -inch off-center hole through the aluminum tube at this point, passing through the gap at junction of the bushing and adapter (parts 9 and 8).
17. Insert rivet and head it. This completes the assembly.

However, there is one additional alteration that will be found helpful, particularly when the spray tank is mounted on a pack board. This is to replace the standard 2- or 3-foot length of hose connecting the tank to the shut-off control with a longer hose. The 3-foot or shorter hose limits movement of the extension tubes; a 6-foot length permits ample freedom of movement and makes it possible to carry the longer extension tubes closer to the center of balance (fig. 4).

It will be noted in the bill of materials that the flexible line specified for the 16-foot extension bears a different manufacturer's number than the lines for 8- and 12-foot extensions. The line for the 16-foot extension is longer, and is recommended because its length allows it to be bent back over the extension tube and taped in that position. This permits the sprayer to use both hands to manipulate the longer, heavier tube and still operate the shut-off valve. With the shorter, lighter tubes, the leverage provided by the use of both hands is not generally needed.

The spray deflector visible at the nozzle end of the tube in figures 1 and 4 is a useful optional attachment when spraying pine leaders. It is a home-made device fashioned from a 1-quart motor-oil can. Both ends of the can are removed, the resulting cylinder is cut lengthwise, and the edges are then pulled apart to leave a gap about 2 inches wide. Then a hole big enough to fit over the male fitting of the nozzle is made in the cylinder wall midway between the ends and about 2 inches from one edge of the gap. The deflector is installed by inserting the threaded end of the



Figure 4.—Sprayer equipped with 6 feet of hose between tank and shut-off valve, which allows the 12-foot extension tube to be carried near its center of balance.

male fitting through the hole so that the cylinder wall rests against the shoulder of the fitting and will be held in place when the female section of the nozzle is attached. Finally, the angle of the deflector should be adjusted so as to be about vertical when the tube is in position for spraying.

In use, the deflector is positioned to surround the pine leader. As the spray solution comes from the nozzle, some of it strikes the near side of the leader and some of it bounces against the deflector to cover the far side.

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